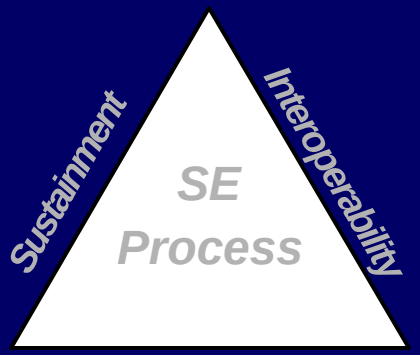
Certified
Naval Battle Groups



Successes and Pitfalls with Introduction of COTS in the Aegis Weapon System

James F. Reagan
Naval Surface Warfare Center, Dahlgren, Virginia

NDIA System Engineering Conference Oct 21-24 2002

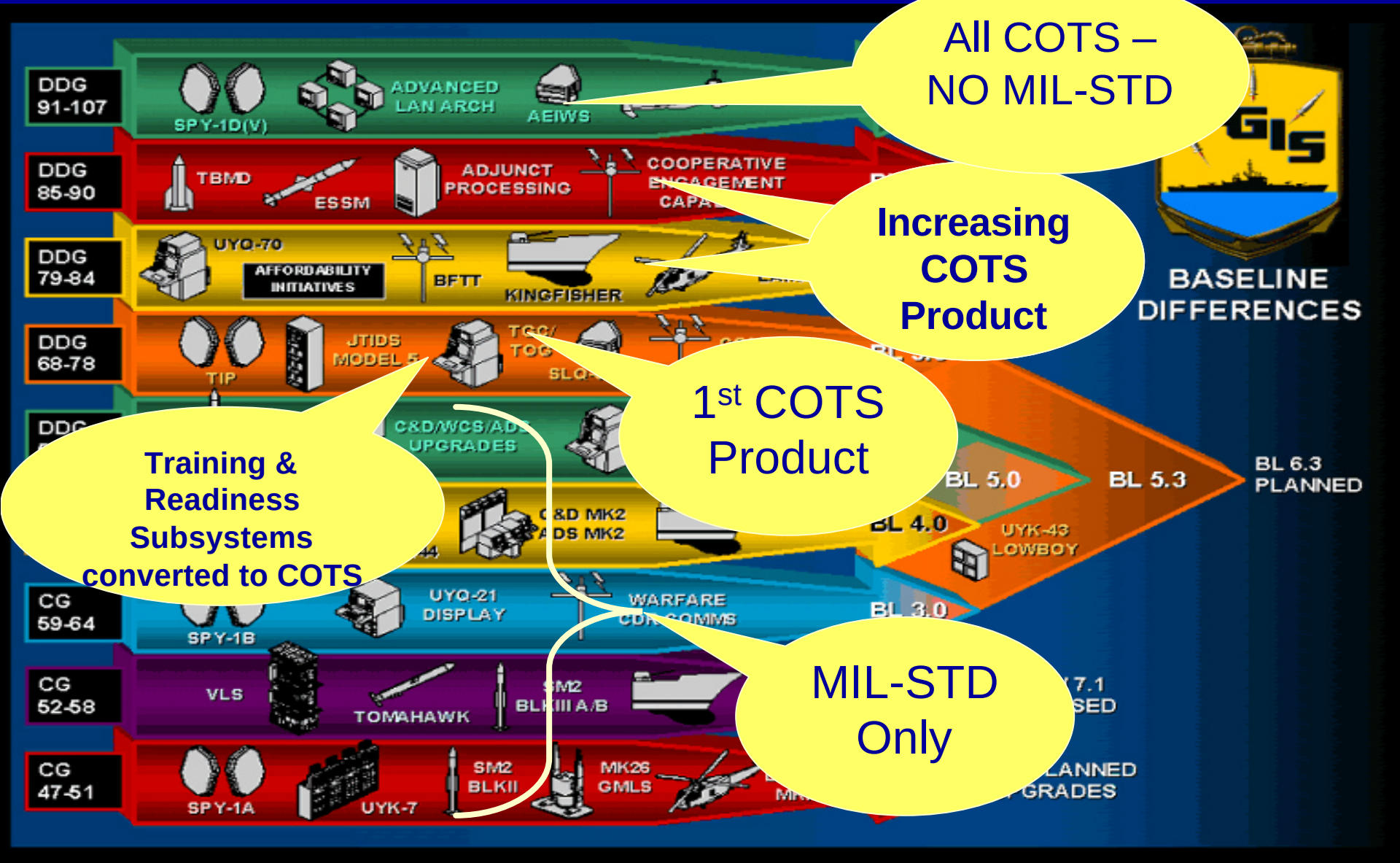
Outline

- Aegis Combat System
- COTS Introduction
- COTS - Theory
- COTS - Reality
  - Good and Bad
- COTS - The Challenge
  - Infrastructure
  - Engineering
- Summary

Aegis Combat System

- *A Highly Integrated Ship Combat System*
- *Aegis Weapon System (AWS) Provides the Anti-Air Warfare (AAW) Capability of the Combat System*
  - *Detection, Control and Engagement for Air Targets*
  - *Very Large and Complex*
  - *Real-Time Intensive with Very Demanding Loop Closure and Control System Response Time Requirements*
- *Long-Standing Development/Production Program*
  - *CG-47 Ticonderoga Class Cruisers Deployed*
  - *DDG-51 Arleigh Burke Class Destroyers Ongoing*
  - *Evolving Requirements Drive Continual Improvements via Baseline Upgrade Program*

Aegis Baseline Progression



COTS – Theory

- Lower development costs
- Faster development
- Leverage the efforts (and mistakes) of many others
- Leverage new technology, stay in the mainstream
- Lower life cycle maintenance costs

COTS - Reality

Good

- COTS offers tremendous computational resources to the Aegis System
- Purchase Cost is significantly less than Development Cost
- Time - available in months vice years
- Significant improvements in HSI

AEGIS Mission Success

COTS – Reality

Bad

- **Loss of Control - Changes, Outstanding Issues, Time, Supportability, etc**
- **Proliferation of Components**
- **Configuration Management becomes more difficult**
- **Delivery and Installation of OE and Applications (Combat and Weapons)**
- **Licenses are problematic**

Technology Insertion is Challenge during Sustainment

COTS – Challenge

Infrastructure:

- Business - Policies, Guidelines, Planning
- Methods - Process, Tools, Configuration Management
- Training

Technical:

- Security
- Testbeds for Replacement Components
- Performance Testing
- Certification

Changing the Cultural

PEO TSC CI/NDI Policy Instruction (PEOTSCINST 4890.1) and Management Plan

1. INTRODUCTION

1.1. PURPOSE

Effective management of Commercial Items/Non-D
challenging and critical to program success and int
exponential rate of change in technology developme
the life of a program. This Management Plan ("Pla
Instruction (PEOTSCINST 4890.1) to assist the PF
insertion and support of non-military items into S
framework to develop, execute, and manage a c
acquisition, integration and life cycle support
encompassing strategy, but rather to sugges
mission requirements.

PEO TSC has Developed An Instruction and Management Plan to aid in the Insertion and Support of COTS Products

-

Performance vs. Lifetime Cost

1.2. SCOPE

This Plan will help users decide "WHAT" factors to consider when designing and integrating CI/NDI. PEO TSC acquisition objectives are to obtain products:

- **that work as intended in their designated environment,**
- **can be repaired without added risk to a ship's mission, and**
- **provide the best long-term value.**

The principles provided here apply to the acquisition and life cycle support of CI/NDI for all PEO TSC programs. Tailor each CI/NDI acquisition process on a case-by-case basis.

Tools To Manage COTS Products

- **TUF/X - Tactical Utilities Function for X-Windows**
  - Provides system access control, configuration protection, and automation of complex maintenance tasks to the ADS, Q-70 Consoles, and NGP
  - Session manager for operators logged onto the NGP
- **ANTT - Aegis Network Test Tool**
  - Determines the physical, network, and application level status of the LANs
- **MSLBGen - Master Server Load Base Generator**
  - Builds/links the Master Server Load Base for Application and OE
- **ASVADS - Automated Software Verification And Distribution Software**
  - Ensures all Q70 equipment has the correct softw
  - Can download and install software upgrades
- **MTT - Maintenance Technician Too**
  - Provides an HTML interface to step the sailor th configure COTS equipment
- **HPOpenview/NNM - Network Node Manager**
  - Verify Status of Local Area Networks

Loading programs over LANs, Testing and Debugging Require Different Tools

We established COTS Working Groups to be clearinghouses for all COTS issues.

- NSWCDD Aegis CI/NDI IPT
- Configuration Management
- Processes/Documentation
  - Standard Operating Procedures
- Delivery V&V Team

Documentation - SOPs

NUMBER	TITLE
N21-SOP-501-ACTS_UNIX	ACTS (UNI[illegible]) QA Build Procedures
N21-SOP-504-ADDGEN	ADDGE[illegible] [illegible]ild Procedures
N21-SOP-505-ADS_MK2	ADS M[illegible] [illegible]uil[illegible] Procedures
N21-SOP-507-DBTOOL	D[illegible]TOOL [illegible]ild Procedures
N21-SOP-508-MUST	[illegible]T QA [illegible]uild Procedures
N21-SOP-509-ORTS_[illegible]	[illegible]MK9 CP QA Build Procedures
N21-SOP-510-[illegible]	[illegible]ORTSMK9/IP QA Build Procedures
N21-S[illegible]P-51[illegible]	TGC QA Build Procedures
N21-SO[illegible]JUNC	C&D/ADJUNCT QA Build Procedures
N21-SO[illegible]TOE	ATOE QA Build Procedures
	CCFTS QA Build Procedures
	TIP QA Build Procedures

Configuration Management

Class	Component	Change Type/Reason	Change Vehicle	Approval	Authorization/ Method	Storage	Tracking Doc/DB	Process Changes
Operating Environment	operating system	version update	IDR	Q70-DCRB ,TCRB other-Elmt	N058/schedulin g BUM/closure BUM	SPM Tape Library	[illegible]	Element, N058
		patch	FDR	Q70-DCRB ,TCRB other-CRB	N058/schedulin g BUM/closure BUM	Elmt [illegible] V&V[illegible]	[illegible]	Element, V&V, N058,
	kernel	hwd driver, swap space, hostname, ip address, patches	FDR	Element	N058/scheduli[illegible] g BUM/clo[illegible] BUM	[illegible]	[illegible]	Element, V&V
	equipment driver	upgrade, obsolete hwd	BL Upgrade, Hardware Replacement	Q70-PMS 400F other-Elmt	[illegible]	[illegible]		ACCESS
	configuration files	host table, router table	FDR	E[illegible]	[illegible]	V&V VOB Elmt VOB	DDD	Element, V&V
	passwords/ accounts	BL Install	Element, [illegible]	[illegible]	[illegible]olicy	CPM Files	CPM Files	CPM
Support Programs	layered product	vers[illegible] upda[illegible]	[illegible]	[illegible]RB	N058	V&V VOB	DDD, ACCESS	
	MSLB						DDD	Element, V&V, CPM
	MTT Lo[illegible] Base	LR[illegible]	N/A	PHD	ACC verification	SPM Tape Library	DDD	Verification Process - NEW
	installatio[illegible] procedure	[illegible]	buil[illegible] memo	Element	CPM	CPM Files	DDD	Element, CPM
	script file	[illegible] [illegible]tion, [illegible]al, [illegible]erator convenience	bui[illegible]memo	DCRB, CRB, Element	N058	V&V VOB	DDD	Element, SCM, V&V

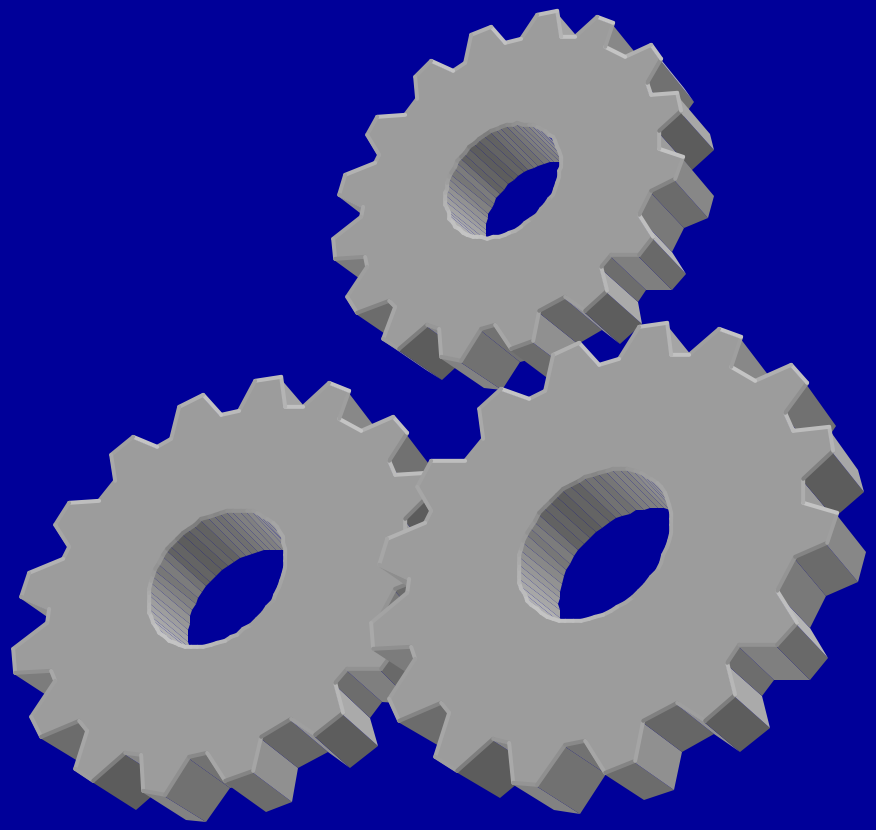
Identify Issues

ISSUES From Dudash Brief on 18 June 2001: OOE Component Management

1. Look at SSDS, etc. for IPs, MACs. other COTS [illegible]
2. LM has group working COTS different from [illegible]
3. LM made mods to vendor-delivered COTS [illegible] 6PI. How about BL 6PIII?
4. Need to work with LM to establis[illegible] [illegible]urations at both ATTs.
5. For BL6PIII, LM is produ[illegible] Re[illegible]ase Memo w/all changes to OEs. Can the process deal with contin[illegible] and [illegible]tions for BL6PIII?
6. BL 6PIII has C++ in [illegible] Elements – Is this necessary?
7. How do we track pr[illegible] [illegible] DCRB for Q70s that aren't being fixed?
8. Should OE p[illegible]CES?
9. What sh[illegible] role and responsibility in tracking OE problems?
10. N61 wil[illegible] problems for C&D/ADS; N13 for SPY & WCS. Is this OK?
11. N21 will [illegible] ship run procedures to get IP and MAC addresses and provide to N21 1-3 week[illegible] before delivery. How is process documented?
12. Why doesn't N27 do ship audits of IPs and MACs?
13. Who will verify that components in ship's stores will work when installed?

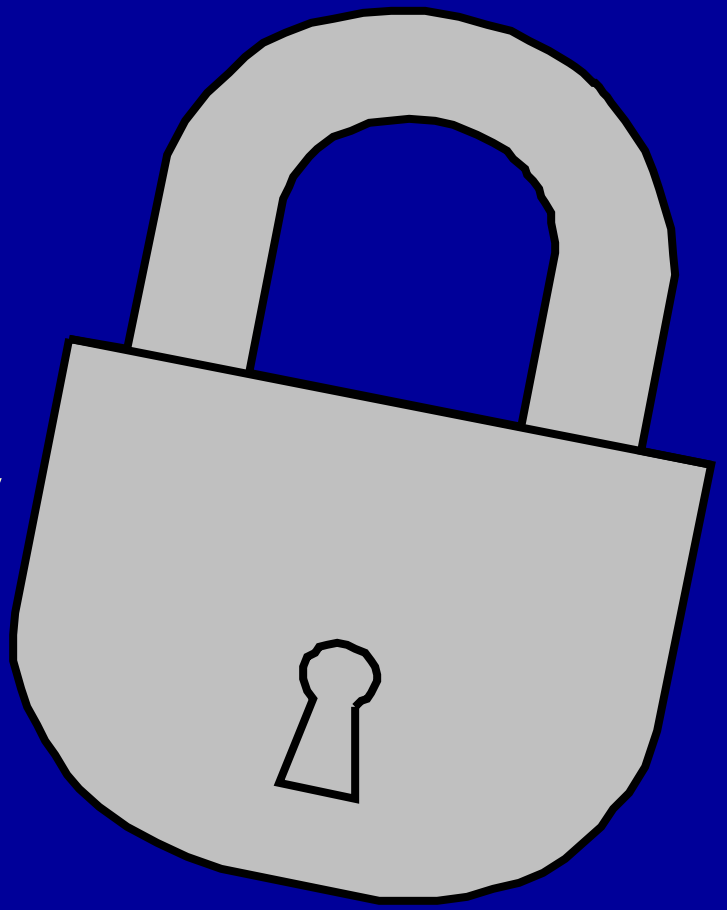
COTS – Technical Challenge

- Security
- Testbeds
- Performance Testing
- Certification

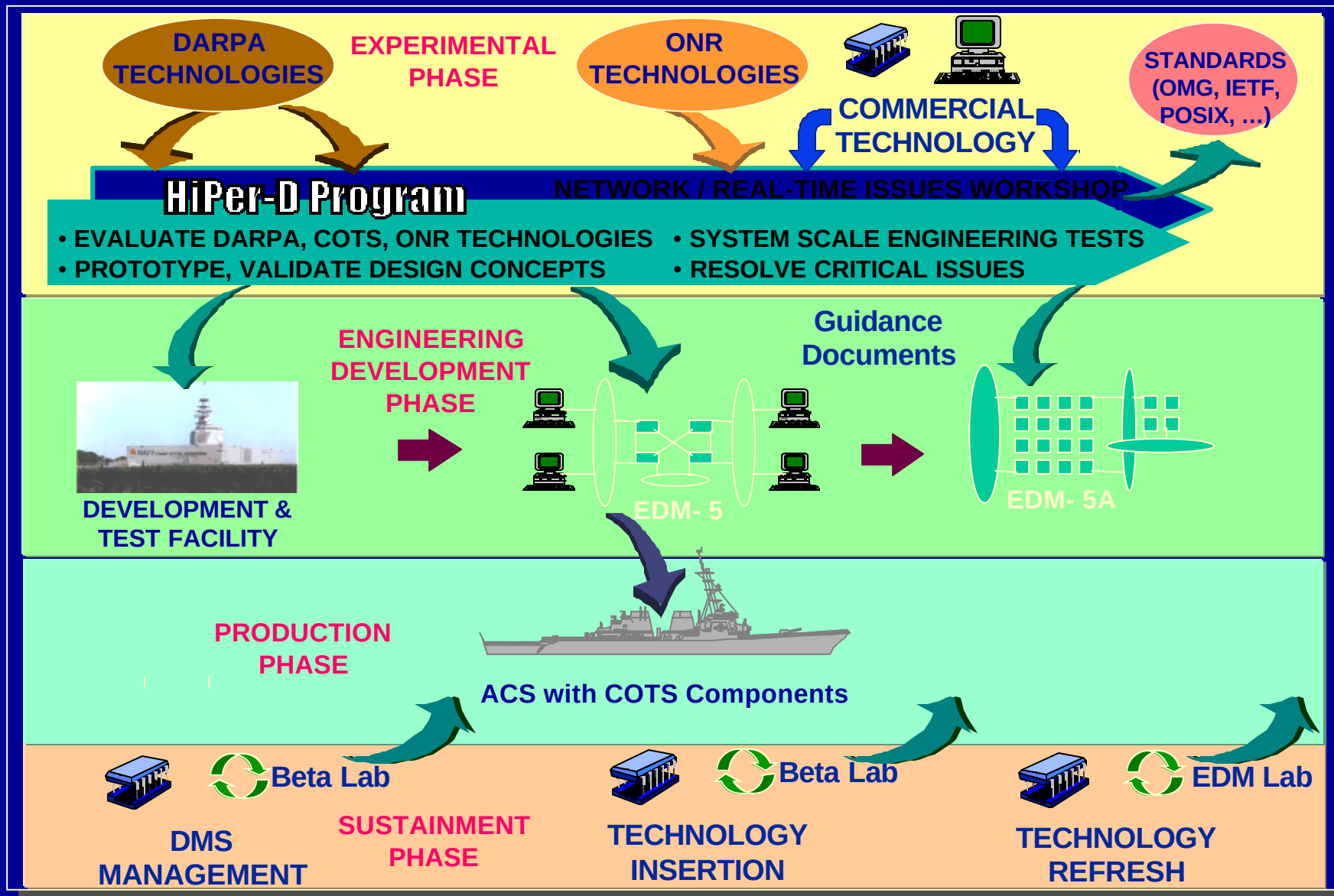


Security

- Legacy code was developed in-house with a team whose members possessed clearances
- Most COTS products have been developed in an open corporate environment
- This places an added burden on the testing & certification team to ensure that the COTS software does not have malicious or easily compromised code
  - Viruses
  - Trojan Horses
  - Phone home features

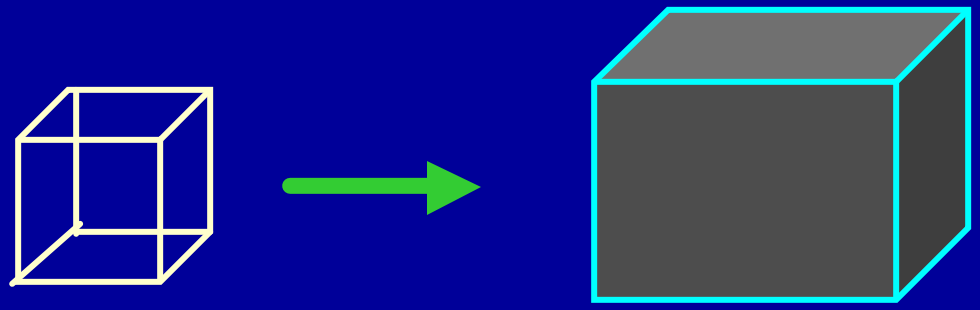


Layered COTS Test Beds



Performance Testing

- Testing is critical
  - to understanding the features available.
  - Determining what changed and the effects on system.
- COTS requires alternatives to white box testing
  - Too large to inspect or completely test
  - Large amounts of code are present but unused



- Integration and System Testing are still Required
  - Old Processes: some still apply, others needed adjustment for COTS

Certification

• Traditionally, Certification involved only the application software – the MIL Spec equipment was supported and tested by another Navy organization.

- Equipment was well defined, computers and replacement parts were identical.

• With COTS, Certification has been expanded to include the operating environment and computing equipment.

- Replacing a board, other components or operating environment changes requires reassessment and possibly re-certification

Accountability Remains with Navy

Summary

- COTS provides Computational Resources - potential
- COTS has also brought many issues
- We have demonstrated the need for the New Architecture for the Combat System
  - A new System Architecture is needed to facilitate COTS utilization
  - Maintenance Concerns must be addressed in Development
- With Planning and Engineering the major COTS issues are manageable

AEGIS Mission Success

Cultural Change is Required for Sustainment of Fleet